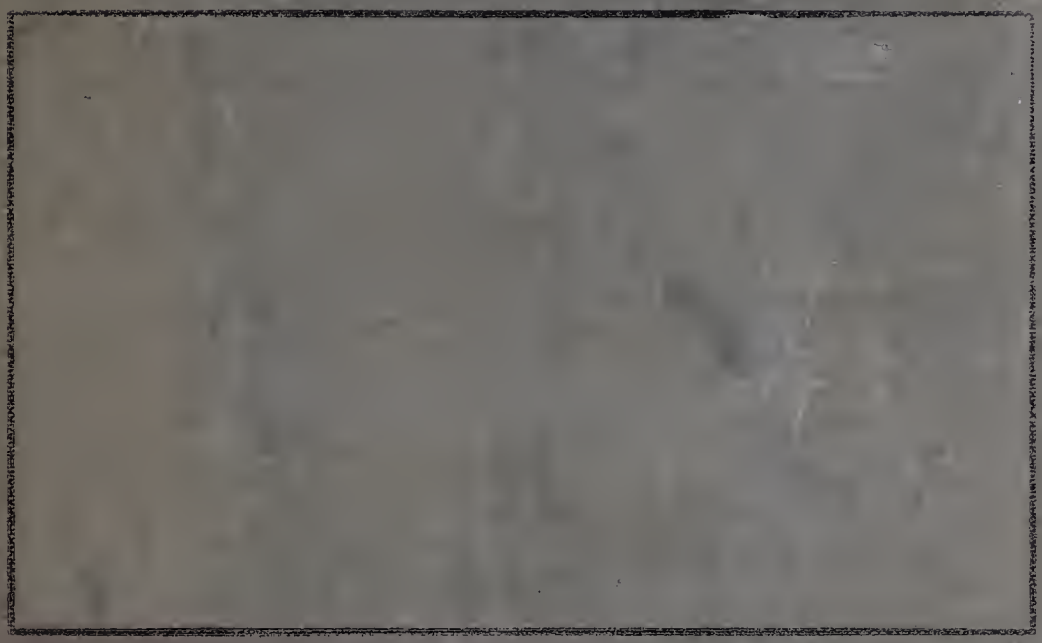
THE STORY BOOK OF IRON AND STEEL



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BY MAUD AND MISKA PETERSHAM

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THE STORY BOOK OF IRON AND STEEL

BY MAUD AND MISKA PETERSHAM

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IRON AND STEEL

IRON

In the early days men had to hunt to obtain food. They had not yet learned to grow vegetables and grain nor to raise animals and fowls for food. And there was not a food market or a store in the whole world.

Although the forests at that time were full of wild animals, it was not easy for men to kill all they needed. Their weapons were too dull. At first they made spears by fastening sharp stones to sticks, but they needed something harder and stronger to use as spearheads. At last a hard metal was discovered.

From certain stones piled about a hot fire, a strange dark substance oozed out and trickled down into the ashes. When it was hot, it was thick like sirup; when it cooled, it was hard.

The hunters were curious about that strange stuff. They began to experiment with it, heating it and pounding it with their stone hammers. They did not know it, but they had discovered the most useful metal in the world: iron! A new age had begun—the Iron Age.

WHERE IRON COMES FROM

The purest iron known comes from the sky. It is found in the meteors which sometimes dash like blazing stars through the air, then fall to the earth. But meteors do not often strike the earth, so there is very little of this iron.

Most iron comes from the earth. You can see signs of it yourself, for it gives a reddish color to the soil and rocks.

Long ago, when the surface of the earth was being formed, iron was also formed. As the years passed, it was slowly separated from the soil and finally deposited in pockets where water had washed away softer substances. Buried away in the earth in many parts of the world there are deposits of iron ore.

EARLY HISTORY OF IRON

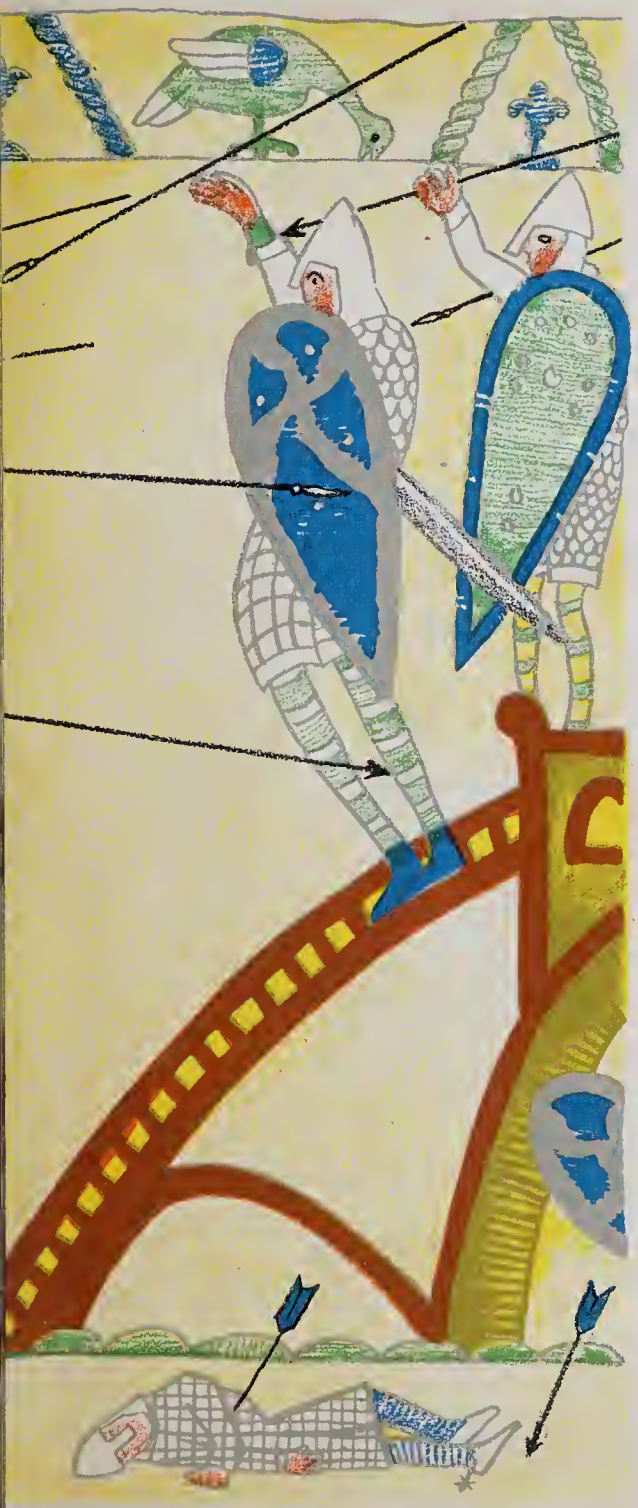
From the time of the pounding of the first iron spearhead, the uses of iron have grown. In all early history there are references to this metal. The oldest iron known is a small piece which was found in an Egyptian pyramid built four thousand years ago. This piece of iron was not an ornament but a tool. Most early iron rusted away, but the dry air in the pyramid kept this tool from rusting.

Sometimes iron is discovered by accident. In ancient days a terrific forest fire swept the island of Crete. After the fire the people found great lumps of iron in the ashes. The people of Crete later became skilled iron-workers.

The ancient peoples of Asia also found many uses for iron. The Assyrians had iron chariots and beautifully made ornaments for their harnesses. They had iron swords and tools. Their saws and files were much like the ones we use today.

The ancient people knew both iron and steel. Steel is made from iron by adding carbon. Steel is brighter and stronger than iron.

WILLIAM THE CONQUEROR 1066
FROM THE BAYEUX TAPESTRY...



Carbon is found in coal and in many other substances. The lead in your pencil is almost pure carbon. A diamond does not look like coal nor like the lead in a pencil, but it is nearly pure carbon.

Wars helped to develop the uses of iron. Ironworkers learned to make shields which a spear could not pierce, swords as sharp as razors, and shining coats of mail.

During the Crusades, which were wars waged by the Christians against the Turks to gain possession of the Holy Land, the Turks and the Arabs became famous for their fine steel. Saladin, a Turkish ruler, had a steel sword that would cut through a feather pillow. In all countries, steel and iron became important. The Spaniards were skilful metal workers. There is no finer steel than that of the old swords of Toledo and Damascus.

When William the Conqueror and his soldiers rode into battle, they wore shining armor of iron and steel and carried steel swords. After his victories, William felt that he owed so much to his iron worker that he raised him to one of the highest ranks in the kingdom.

At first iron and steel were very expensive because it took so long to get the iron from the ore. In Sparta iron was even used for money. Alexander the Great plundered iron as well as gold from India. Only six hundred years ago, iron pots and pans were classed among the royal jewels.

EARLY FORGES

Separating the iron from the ore is called smelting. At first smelting was done in a very simple way. The iron ore was put in a hot fire of charcoal and the iron melted and trickled out forming a lump of metal.

Ironworkers soon learned that the hotter the fire the greater the amount of metal they would get. So they built their fires on hilltops or in other places where the wind would make the fires burn intensely. But sometimes the wind blew and sometimes it did not. It could not be depended upon to keep the fires hot. Finally other ways of getting a blast of air into the fire were discovered. This simple change has made it possible to produce great quantities of iron and steel.

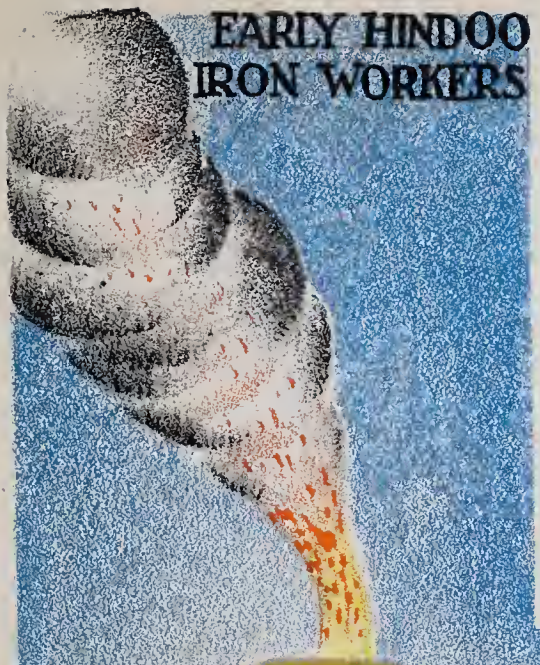
FROM OLD EGYPTIAN PAINTING

The early metal workers blew into the fire through a hollow cane or tube. This was hard, slow work. Then different kinds of bellows were made to force air into the fire.

EGYPTIAN BELLOWS

The Egyptians used a bellows made of two goatskins connected by a pipe which carried the air into the fire. A man stood with one foot on each skin, putting his weight first on one skin, then on the other. With his hands he pulled cords which lifted the upper part of the skins and let the air come in through a hole in the top.

Other kinds of bellows were invented. Some were worked by hand and some by water power.



Finally forges or furnaces were built to hold the fire in which the iron ore was smelted. The first ones were very crude. Layers of charcoal and iron were piled high. Then this was covered with a rough coating of stones or mud to keep in the heat. There was a hole at the top to let out the smoke and one at the bottom to let in the air. In a furnace like this it would take several days to melt out a few pounds of iron.

The Spanish ironworkers of Catalonia built a better kind of furnace. The air was forced in by huge bellows worked by hand or water power. This Catalan forge was used by ironworkers all through the Middle Ages.

The demand for iron and steel was so great that ironworkers began to build bigger furnaces and to force more powerful air currents through the fire.

At first wood and charcoal were burned in these furnaces, but it took an immense amount of fuel to get the metal out of the ore.

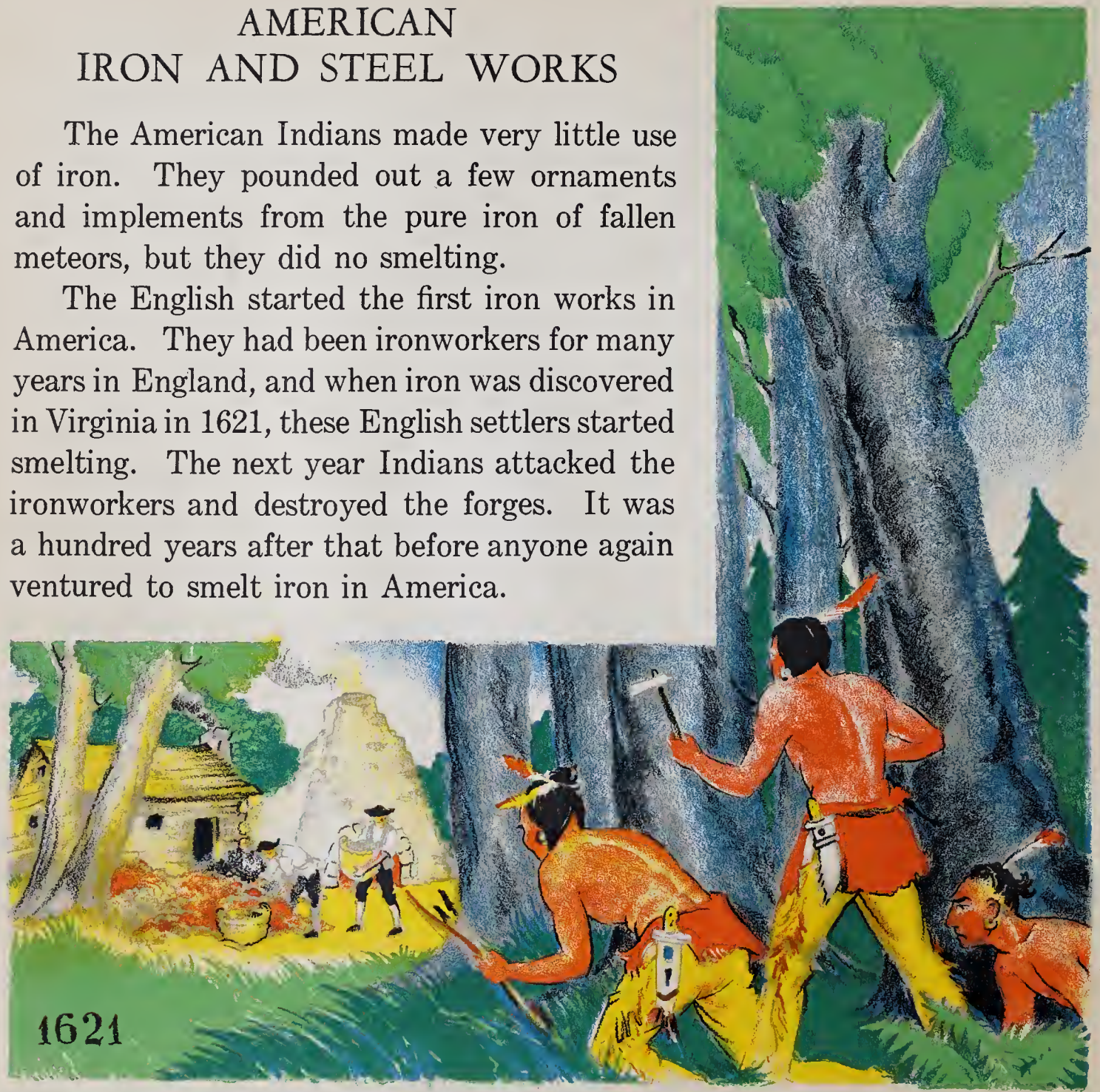
In England so many trees were cut down for fuel for the ironworkers that the forests began to disappear. The shipbuilders were afraid that there would be no trees left to supply timber for their ships, so a law was passed forbidding trees to be cut for fuel.

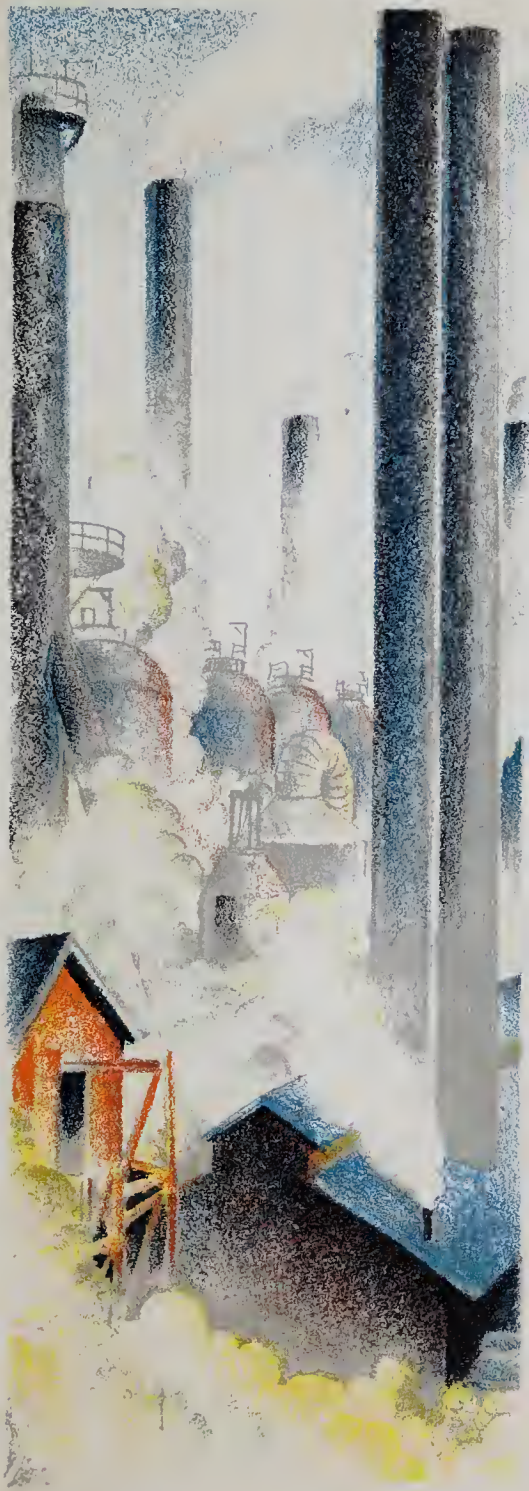
A new fuel had to be found, and coal came to be used in the forges. Later, coke, which is made from coal, took the place of charcoal, and is still in general use.

AMERICAN IRON AND STEEL WORKS

The American Indians made very little use of iron. They pounded out a few ornaments and implements from the pure iron of fallen meteors, but they did no smelting.

The English started the first iron works in America. They had been ironworkers for many years in England, and when iron was discovered in Virginia in 1621, these English settlers started smelting. The next year Indians attacked the ironworkers and destroyed the forges. It was a hundred years after that before anyone again ventured to smelt iron in America.





A great deal of iron ore was found in America, and at last many small iron works were started. The early American ironworkers made cast-iron stoves, pots and pans, teakettles, shovels, plows, and cannons.

Then the railroad came, and the demand for iron and steel was tremendous. The locomotive, called the "Iron Horse," demanded steel rails to run on, and steel, as you know, comes from iron. In a few short years the iron and steel industry grew into a giant.

Today, in America, there are many gigantic mills that smelt tons of iron ore each day to meet the demand for steel.

Steel makes bridges and skyscrapers. Steel is a part of every automobile. Locomotives, trains, rails, tools, delicate watch springs are all of iron or steel.

Work in iron and steel has become the greatest industry of all time. And in their production America leads the world. All countries use steel and iron tools and machinery made in America.

IRON ORE

America is rich in iron ore. The finest iron ore known is found in Pennsylvania, Virginia, and New Jersey. And the masses of iron ore around Lake Superior are greater than any other known deposits in the world. Whole mountains of iron ore have been dug out of this region.

Some iron-ore deposits are found near the surface of the earth. Others are deep in the ground. Often great holes are made in the earth where the ore has been lifted out by big steam shovels.

The shovels are either of iron or steel, and they can scoop up tons of ore by the mouthful and then spit it out into waiting cars that carry it to the docks. Where many shovels are working at once, it takes only a few minutes to load a train of cars. When iron ore reaches its destination, big machines quickly unload it.

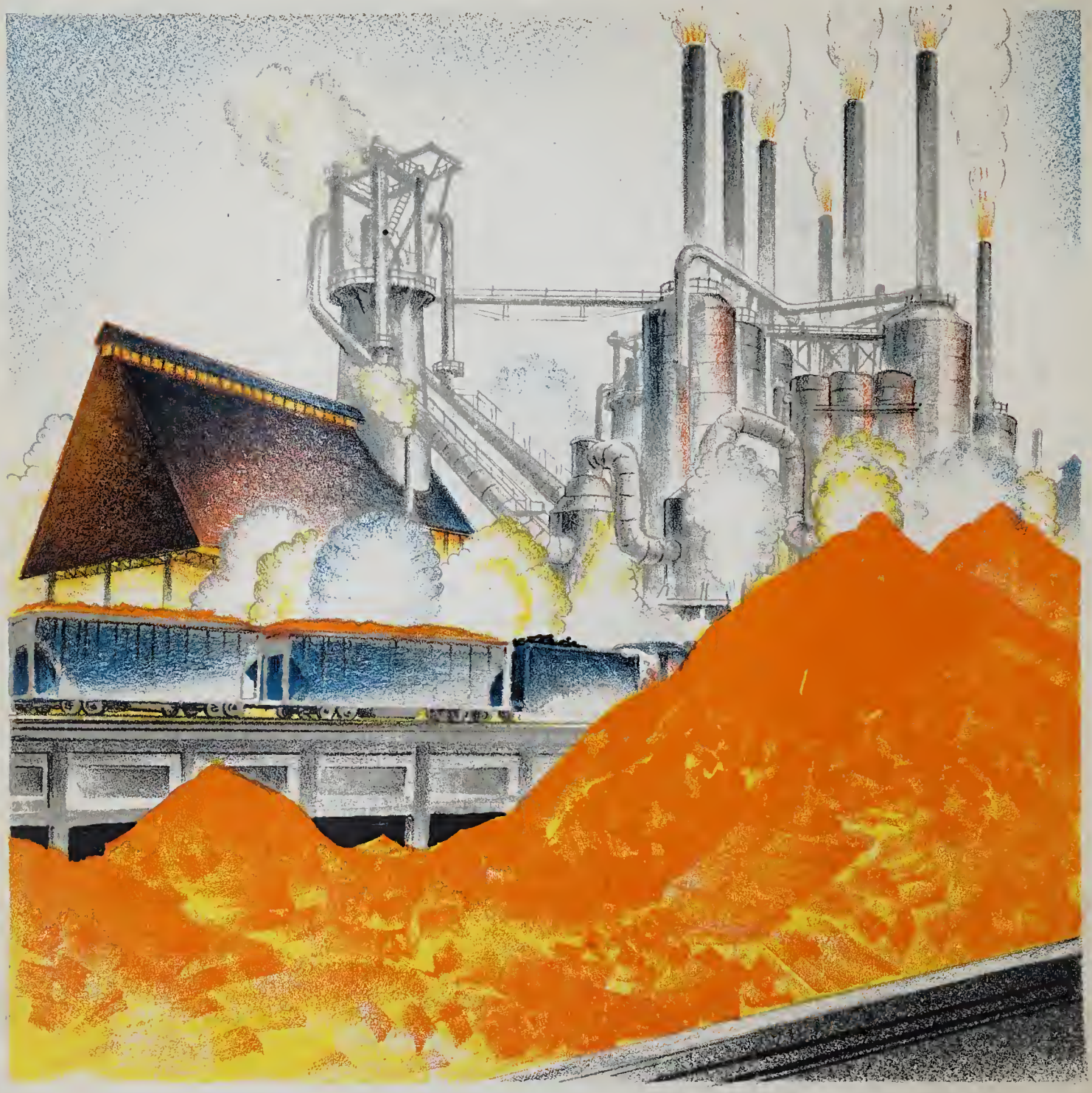


DIAGRAM OF
BLAST FURNACE

Huge piles of the iron ore are stored about the blast furnaces and in these furnaces the iron is melted out from the ore.

BLAST FURNACES

The blast furnace which grew from the simple forge is like some huge monster blowing out sparks and fire. It is a great chimney rising into the air one hundred feet or more. And from top to bottom it is filled with a roaring, red-hot fire.

Into the top of the blast furnace are dumped carefully measured amounts of iron ore, coke, and limestone. These materials melt and mix, then separate. The limestone and the impurities of the ore separate and form a stuff called slag.

After four or five hours of terrific heat, two doors at the bottom of the furnace are thrown open. From the upper door flows the slag. From the lower door pours a glowing, blinding stream of hot liquid iron.

Giant buckets, called ladles, receive the fiery mass and carry it away. Then it is molded into pieces called pigs. Each pig weighs about one hundred pounds.

This odd name, *pig iron*, is a left-over from old-time methods of molding the iron. In olden times the liquid iron was run off into molds in the sand, several small molds running off from the main one. This group of molds reminded the ironworkers of a mother pig suckling her young. Ever since, these pieces of molded iron have been called *pig iron*.

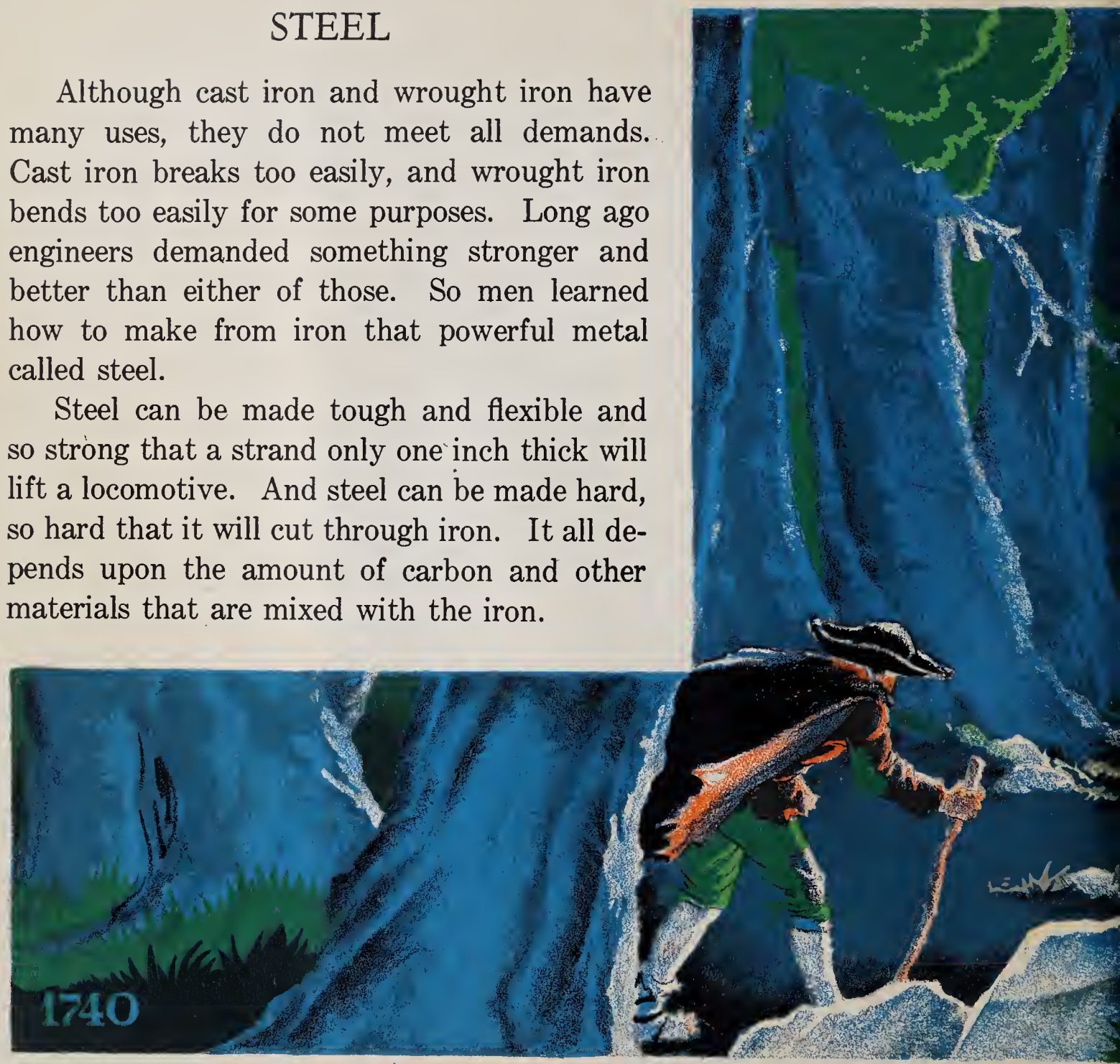
All iron contains some carbon. Cast iron contains a great deal of carbon and is brittle. But it molds better than any other kind of iron and has many uses. Wrought iron has very little carbon and can be twisted and worked into beautiful shapes. You may have seen gates or wall pieces made of wrought iron.

Even slag is valuable. It is used in cement. Besides its use for roads and other things, it is sometimes used to make railroad beds firm for the steel rails.

STEEL

Although cast iron and wrought iron have many uses, they do not meet all demands. Cast iron breaks too easily, and wrought iron bends too easily for some purposes. Long ago engineers demanded something stronger and better than either of those. So men learned how to make from iron that powerful metal called steel.

Steel can be made tough and flexible and so strong that a strand only one inch thick will lift a locomotive. And steel can be made hard, so hard that it will cut through iron. It all depends upon the amount of carbon and other materials that are mixed with the iron.



Early ironworkers found it hard to make steel, because the results were uncertain and the process expensive. Now, men can make cheap reliable steel.

In 1740, before America had her own flag, there lived in England a clock and watchmaker named Benjamin Huntsman. He was a careful workman and realized that he needed better steel for the springs of his clocks and watches. So he decided to experiment with iron himself and see what he could make.

Deep in the forest, Huntsman built a forge. There no one could spy on him as he worked, and at last he found a way of making better steel.

Soon all the neighboring ironworkers wanted to find out his secret. Finally one of them, dressed in rags and pretending to be lost in the woods, came to the door of Huntsman's forge. Huntsman unlocked the door and let the ragged stranger in. Before the scamp left, he had learned Huntsman's secret. It was a slow, expensive method. Yet it was a hundred years later before the ironmasters had found a sure and cheap way to make large amounts of good steel.

BESSEMER CONVERTER

Another Englishman, Sir Henry Bessemer, found a cheap, quick way of turning pig iron into steel. In a container, which he called the Bessemer Converter, he could change pig iron into steel in thirty minutes. He made his great discovery in 1856.

The Bessemer Converter is a great egg-shaped steel container lined with clay which will hold two tons of liquid pig iron. It is made so that a blast of air can be forced in at the bottom and up through the liquid metal.

When the air goes through this hot liquid iron, there is a terrific roar. The converter is "blowing off." Out of the top of the converter burst millions upon millions of glowing sparks and tongues of red and yellow flames. The carbon and impurities are being burnt and blown out of the iron. It is the grandest sort of fireworks display.

Just the right amount of carbon is added, and the molten iron becomes steel. The liquid steel is then poured into ladles and carried to molds where it cools.

A man wearing heavy glasses to protect his

eyes from the blinding heat and light walks on a bridge where he can examine the converter. When it is empty, he gives a signal and the container is swung back into position ready to receive another batch of liquid iron.

OPEN HEARTH PROCESS

The Bessemer Steel Process is suitable for heavy objects, such as rails for railroads, car wheels, and plate steel for ships. Yet it does not meet all needs, so other ways of making steel are used.

The process most used today is called the Open Hearth Process. It is a slower method but it makes steel of finer quality.

In this process the container looks like a huge baker's oven. Pig iron, scrap iron, and limestone are piled in and heated together. As the batch melts, it is tested to see how much carbon is needed to make steel. This amount is added, and the liquid iron becomes liquid steel.

When the batch has been heated to the right point, a door is opened, and the glowing mass flows out into ladles.

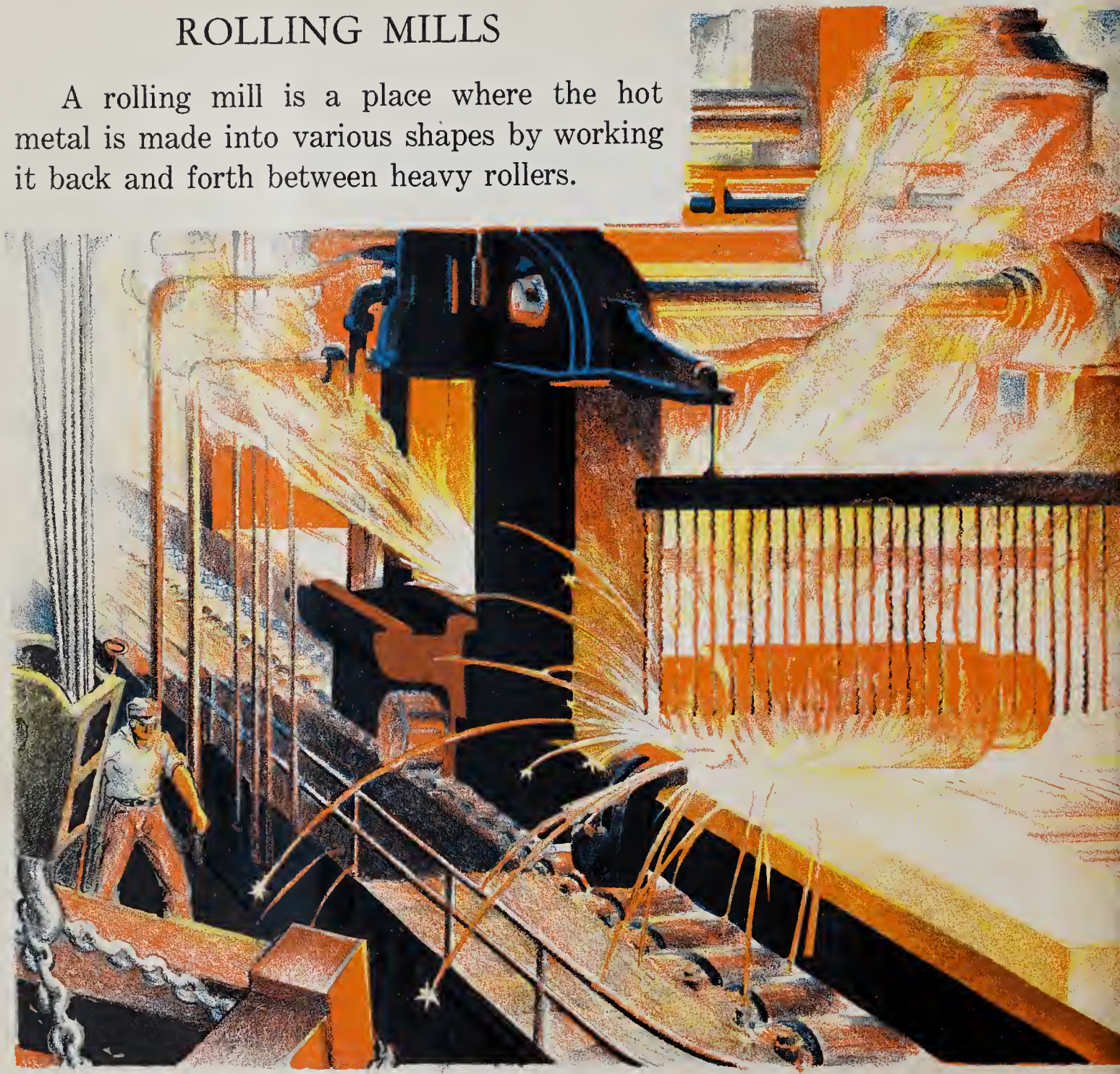
The slag, which floats on the surface of the steel in the ladle, overflows into smaller vessels.

The ladles are carried by machinery to molds into which the liquid steel is poured. The molds are on cars so that the hot steel can be hauled out into the air to cool.

THE STEEL IS REHEATED IN THE SOAKING PITS

ROLLING MILLS

A rolling mill is a place where the hot metal is made into various shapes by working it back and forth between heavy rollers.



As the sheets and bars of hot steel pass between the rollers, they sizzle and crackle, and bright sparks fly in every direction. If a rail for a railroad is being made, it is shaped and punched by powerful machines. The ends are cut off by whirling saws, and the steel rail is finished.

In a similar way hundreds of other useful articles are made of steel. Great beams for bridges, steel plates for ships, steel girders for skyscrapers are all shaped between these huge rollers.

From the time the iron ore is scooped up by steam shovels until it leaves the steel mill, the human hand does not touch it. Machines, like huge giants, do the work.

But men make the machines, and men do the thinking. Men have been thinking and experimenting with iron and steel ever since early man discovered iron. We can hardly imagine what our busy world would be like today without iron and steel. If you will count the uses of iron and steel in our tools, our machines, in our homes, schools, and streets, you will see that iron is really one of the earth's greatest treasures.

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IRON ORE, COKE AND LIMESTONE ARE PUT IN TOP OF BLAST FURNACE

IT IS A ROARING FIRE

IT IS ONLY WASTE SLAG BUT IT IS USED IN MAKING CEMENT

SLAG

PIG IRON

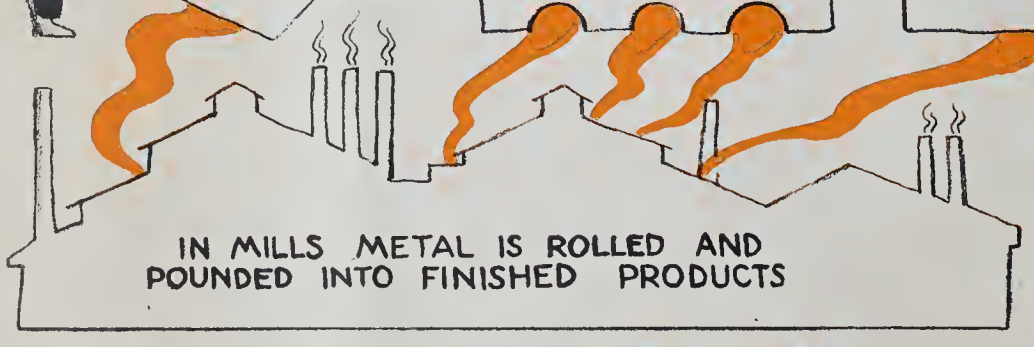
I MUST ADD JUST SO MUCH CARBON TO MAKE STEEL

BESSEMER CONVERTER

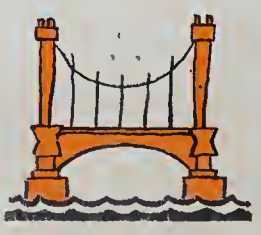
OPEN HEARTH FURNACE

WROUGHT IRON

CAST IRON



IN MILLS METAL IS ROLLED AND POUNDED INTO FINISHED PRODUCTS



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